Parallel and Serial Port Comparisons

By George Ellson, courtesy of Salem Computer User's Guide and Apple Computer Technical Notes.

Parallel Ports:

The most common parallel port implementation is the "Centronics port. The centronics port is used primarily to connect the computer to printing devices. The Centronics port is suitable for applications where the cable connecting the computer and printing device, is short (about six feet is the recommended limit).

A major advantage of the Centronics port is simplicity. There are few variations, and cable connections are clearly specified in the implementation so you can plug in the cable and start printing. Another reported advantage is speed, although you are already communicating faster than you can print, more speed doesn't buy much.

In a Centronics port the data is one direction only, there are status lines coming back from the printer but they have assigned meanings. The status lines indicate conditions at the printer, is there paper in the printer and is it ready to accept data.

The computer checks the status lines and, if the printer is ready for data, presents eight bits of data on a set of eight linesw followed by a signal (called a strobe) on another line to indicate that data is available. The signals used in this interface standard are compatible with the signals used within the computer and printing device. This technique is the simplest means of sending information from the computer to another device.

The name "Centronics" comes from the company who established the standard. Centronics was one of the first manufacturers of general purpose printers, in particular the "Dot matrix" printer. Centronics produced a high quality but low cost printer (well it was low cost in comparison with the printers available in the early 1970 era anyway), part of their strategy was to produce one version of printer that could run on all computers.

Centronics established and documented a standard printer interface then spread the word, and copies of the specification, to computer manufacturers. Demand for the Centronics Dot Matrix printer forced the computer manufacturers to provide a Centronics interface and it became the DeFacto standard.

Serial Ports:

The most common serial port is the RS-232-C, more commonly referred to as simply "RS-232". The RS-232 port is used for a variety of data passing tasks, including passing data to printers. The RS-232 port is suitable for communicating over longer lines than the Centronics port, fifty feet is the recommended maximum length (although, under certain conditions, it has been known to work reliably over as far as 300 feet).

In the RS-232 port data is bi-directional and is transmitted one bit at a time over two isolated signal paths, one for each direction. The RS-232 standard specifies a set of status lines and control signals, called "Handshake" signals to govern the transfer of data. Transmission of one character is achieved by transmitting each bit for a prescribed amount of time, the time (or actually 1/the time) is called the "Baud Rate". The technique used in serial communications dates back to the electromechanical Teletype machines. The first bit transmitted is a start bit, always a space or logical 0, followed by the agreed number of data bits and ending with a stop bit consisting of one or more mark or logical 1s.

For each transmission path there is a compaion hand shake signal, the signal comes from the receiving end of the path. The conversion to serial format is usually accomplished with an integrated communications chip designed to perform these functions. It is common for communications chips to require these hand shake signals before it will operate. It is equally common to wire the cable in such a way that the hand shake signals are always true, overriding the hand shake altogether.

The RS-232 specification was developed during a time when the equipment in question was either a terminal or a modem. The specification talks in terms of Data Terminal Equipment (DTE) and Data Communications Equipment (DCE), the hookup different for each. The trick is to figure out which your equipment is.

In addition there are few applications that fully

implement RS-232, many applications assign other uses to the signals not implemented. Couple this with a lack of standardisation on the gender of the connectors that are used and you have a formula for a poor implementation success rate. Do not be discouraged though, when it is connected up properly the RS-232 port provides extremely reliable communications.

Serial port implementations, in addition to the correct electrical comnnection, require several protocol parameters to be met. The parameter of concern are Baud Rate, Stop Bits, Data Bits, Parity and handshak protocol.

Baud rate as I mentioned earlier, is the data bit transfer rate. Common baud rates are 300, 1200, and 2400 baud. Baud rates for printer can vary, most are specified with switch settings on the printer. The fastest baud rate supported by MS DOS 2.x is 9600 but many IBM PCs and clones can go up to 19,200 baud with special software. As a rule of thumb the character (per second) transfer rate is 10% of the baud rate (there are effectively 10 bits per serial character, the start bit, stop bit and 8 data bits).

Stop bits are the number of marking states required for your machine to re-synchronise on the next character. The Stop Bit specification is a function of the overhead to process a character, it is rare for a modern machine to require more than one stop bit, but specifying two stop bits can't hurt (it only slows the character transfer rate by 10% and, if it is needed, can prevent strange characters).

Data bits is the number of its used for actual data, it does not include the Start, Stop and Parity bits. The common settings are 8 data bits if no parity is used and 7 if parity is used. Parity is an error detection technique, the use depends on the service, most Bulletin Boards use 8 data bits and no parity, most UNIX and ZENIX implementations use parity, most commonly Even parity, and 7 data bits.

Parity can be always 1, always 0, Even parity, Odd parity, or No parity (the time slot contains a valid data bit). The parity definition specifies the condition of the bit preceding the stop bit. Always 1 or always 0 are simply place holders and do not provide error checking. Even and Odd parity are techniques for detecting an error resulting from missed or stuck bits. Even parity means that the number of marking data bits (binary 1s) is always an even number, this includes the data and the parity bits but not the start and stop bits.

In even parity, if the number of marking data bits is an odd number the parity bit is set to mark (making the total an even number) otherwise it is space. Odd parity, as the name implies, does the same thing but uses the parity bit to make the total an odd number. The parity bit is calculated when the data is transmitted, when the data is received the parity is calculated again but over the data parity bits, if the result is not correct (an even number for even parity or odd number for odd parity) a parity error is indicated.

Handshake protocol can be either hardware or software, in hardware handshake the system relies on the handshake signals to control the data transmission. In software handshake the receiving unit controls the transmission of data by issuing a special character to start transmission (XON) and another to stop transmission (XOFF). The transmitting unit monitors it's receiving line for the specila character while it is transmitting data on the tranmit line.

Hardware handshake is common between equipment intended to be connected directly and software handshake is common on equipment connected using a modem. This convention is primarily due to the fact that Asynchronous modems (most common and affordable type) do not reproduce the handshake signals.

The RS-232 standard comes from the Electronics Industries Association as a Recommended Standard (the number has no particular meaning, it is just the order in which this specification was filed). The original RS-232 specification was developed in cooperation with the telephone company and EIA during the 1960s. The specification has been re-written recently, in three variations, and distributed as RS-422, RS-423 and RS-449 but the new specifications have not been universally implemented in the personal computer industry.

Hint for troubleshooting parallel ports, if it doesn't work, check your interface card and your printer, it isn't likely that the problem is in the cable;

- A few hints for serial ports. If there is nothing happening, check the cable for data lines and handshake lines connected properly. If there is something happening but only garbage, or occasionally garbage is being printed, check the baud rate settings. If everything looks right but occasioanlly caharcters are missing, check the parity setting, it is common for characters with parity errors to be ignored.

Only three connections are essential to serial communications, they are;

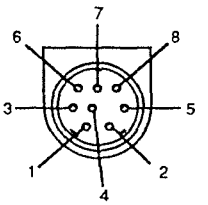
1 Frame Ground
2 Transmitted Data (or Received sometimes)
3 Received Data (or Transmitted - sometimes)

Pin	Name	Function
1	FG	Frame Ground
2	TXD	Transmitted Data
3	RXD	Received Data
4	RTS	Request to Send
5	CTS	Clear to Send
6	DSR	Data Set Ready
7	SG	Signal Ground
8	DCD	Data carrier Detect
9		Positive DC test voltage
10		Negative dc test voltage
11	QM	Equaliser Mode
12	(S)DCD	Sec. Data Carrier Detect
13	(S)CTS	Sec.Clear to Send
14	(S) TD	Sec. Transmitted Data
15	TC	Transmitted
16	(S)RD	Sec. Transmitted Data
17	RC	Receiver Clock
18	DCR	Divided Clock, Receiver
19	(S)RTS	Sec. Request to Send
20	DTR	Data Terminal Ready
21	SQ	Signal Quality Detrect
22	RI	Ring Indicator
23		Data Rate Selector
24	(TC)	Ext.Transmitter Clock
25		Busy

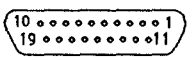
DE-9

MINI DIN-4

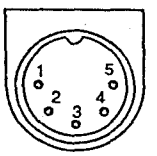
DA-15



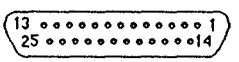
MINI DIN-8



DB-19



DIN-5



DB-25

Macintosh Cable Pinouts

N.B.: Positive voltage equals binary "Zero", signal "Space", control ON. Negative voltage equals binary "one", signal "Mark", control OF.

Connector hints; While it is common to find female 25 pin sockets on equipment and "male" plugs on the end of cables, this is not mandatory. Should you find the ends incompatible (say with a Houston plotter) it is possible to buy a "Gender Bender" - male to male, or female to female conversion plug. Similarly if you need to connect two "transmitting" devices, like two computers together, then you will need to swap the transmit/receive lines of your cable. This can be done by what is called a "NULL MODEM" plug.

Note for the cable descriptions below:
1. The arrows ("--->") show which side is an input and which is an output. For example, the notation "a ---> b" means that signal "a" is an output and "b" is an input.
2. When pins are said to be connected on a side in the Notes column, it means the pins are connected on that side of the connector.

Macintosh Imagewriter Cable (part number 590-0169)

Macintosh (DB9)	Name			Imagewriter (DB25)	Notes
1	Ground			1	
3	Ground			7	pins 3, 8 connected on Macintosh side
5	TxD-	--->	RD	3	RD = Receive Data
7	HSK	<---	DTR	20	
8	RxD+	=	GND		Not connected on Imagewriter side
9	RxD-	<---	SD	2	SD = Send Data

Macintosh Modem Cable (Warning! Don't use this cable to connect 2 Macintoshes!) (part number 590-0197-A)

Macintosh (DB9)	Name			Modem (DB9)	Notes
3	Ground			3	pins 3, 8 connected on EACH side
5	TxD-	--->	TxD	9	
6	+12V	--->	DTR	6	
7	HSK	<---	DCD	7	
8	No wire			8	
9	RxD-	<---	RxD	5	

Macintosh to Macintosh Cable (Macintosh Modem Cable with pin 6 clipped on both ends.)

Macintosh (DB9)	Name			Macintosh (DB9)	Notes
3	Ground			3	pins 3, 8 connected on EACH side
5	TxD-	--->	RxD-	9	
7	HSK	<---	DCD	7	
8	No wire			8	
9	RxD-	<---	TxD-	5	

Cable 590-0191

DIN-5 Male	DB-25 Male
1	6
2	3
3	7
4	2
5	20

Used to connect the following devices:

Apple IIc to a Daisy Wheel Printer, Scribe, ImageWriter, or Color Plotter.

Cable 590-0192

DIN-5 Male	DE-9 Male
1	6
2	9
3	3
4	5
5	2
Case Shield	8

Used to connect the following devices:

Apple IIc to a Modem 300 or Modem 1200.

Cable 590-0197

DE-9 Male	DE-9 Male
3 & 8	3 & 8
5	9
6	6
7	7

Used to connect the following devices:

Apple IIGS to a Modem 300 or Modem 1200 (also requires cable 590-0341).

Macintosh or Macintosh Plus to a Modem 300 or Modem 1200 (Macintosh Plus also requires cable 590-0341).

Cable 590-0121

DE-9 Male	DB-25 Male
3	7
9	2
7	8 & 5
6	20
2	6
5	3
8	1

Used to connect the following devices:

Apple II, II Plus, IIe High Speed Serial Card or Super Serial Card to a Modem 300 or Modem 1200.

Apple III, III Plus to a Modem 300 or Modem 1200.

Lisa/Macintosh XL to a Modem 300 or Modem 1200.

Cable 590-0335

Mini DIN-8 Male	DB-25 Male
1	20
2	6 & 8
3	2
4 & 8	7
5	3

Used to connect the following devices:

Apple II, II Plus, IIe High Speed Serial Card or Super Serial Card to an ImageWriter II or Apple Personal Modem.

Cable 590-0340

Mini DIN-8 Male	Mini DIN-8 Male
1	2
2	1
3	5
4	4
5	3
6	8
7	7
8	6

Used to connect the following devices:

Apple IIGS to an ImageWriter II or Apple Personal Modem.

Macintosh Plus to an ImageWriter II or Apple Personal Modem.

Cable 590-0341

Mini DIN-8 Male	Mini DE-9 Female
1	6
2	7
3	5
4	3 & 1
5	9
6	4
8	8

This is an adaptor cable used to connect DE-9 cables to devices with Mini DIN-8 ports.

Cable 590-0169

DE-9 Male	DB-25 Male
1	1
3 & 8	7
5	3
7	20
9	2

Used to connect the following devices:

Apple IIGS to a Scribe, ImageWriter, or Color Plotter (also requires cable 590-0341).

Macintosh or a Macintosh Plus to an ImageWriter (the Macintosh Plus also requires cable 590-0341).

Wiring hints: If you decide to wire your own cables, follow the following simple rules;

1. Make a wiring diagram of the interconnections.
2. Draw the pin layout- showing the pin numbers from the soldering end (the pin numbers are often visible on the plastic part of the plug, although you may need a magnifying glass to see them.
3. Make sure that wire strands do not touch adjoining pins.